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(54) METHOD FOR TRANSFERRING AN ENCRYPTION KEY

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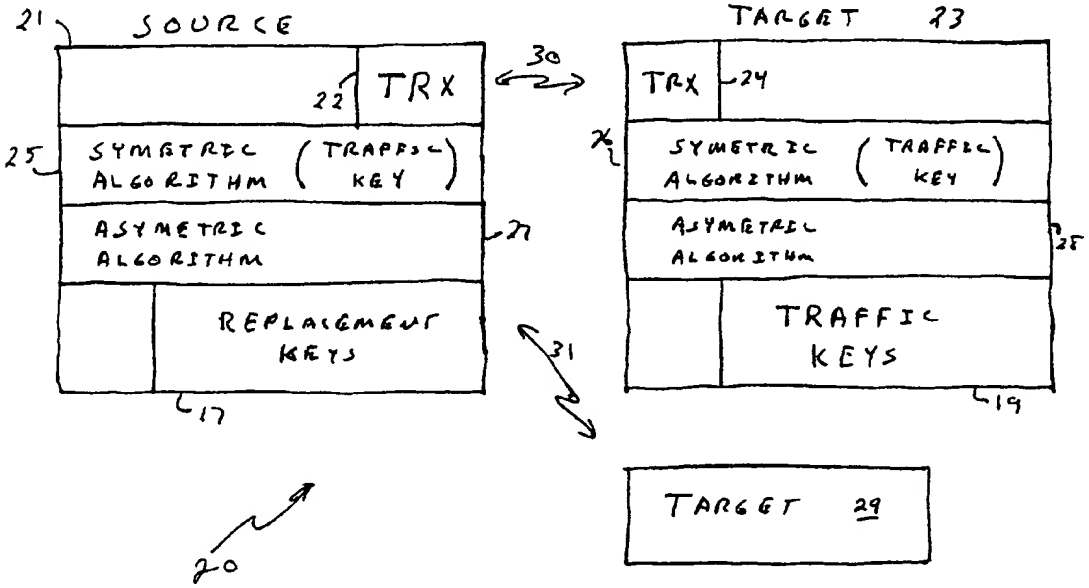
(57) ABSTRACT

Encryption keys are transferred by obtaining a public and private key pair (42, 65) from a source device (21, 61). The public key is transmitted (42, 65) from the source device (43, 66) to a target device (23, 62). The target (23, 62) obtains a traffic key (44, 67) stored within the target device (23, 62). The traffic key is encrypted (45, 68) within the target device using the public key. The encrypted traffic key is transmitted to the source device (46, 69) where it is decrypted (47, 70) using the private key. The replacement encryption key(s) is(are) encrypted using the traffic key by the source device (48, 71) forming an encrypted replacement key message which contains a target slot identification for each of the replacement encryption keys. The encrypted replacement key message is transmitted to the target device (49, 72) where the replacement encryption key(s) is(are) recovered (50, 73). The replacement encryption key(s) is(are) then stored at the target device in an identified target slot (51). The public, private, and traffic keys may then be erased from the source and target devices as appropriate.



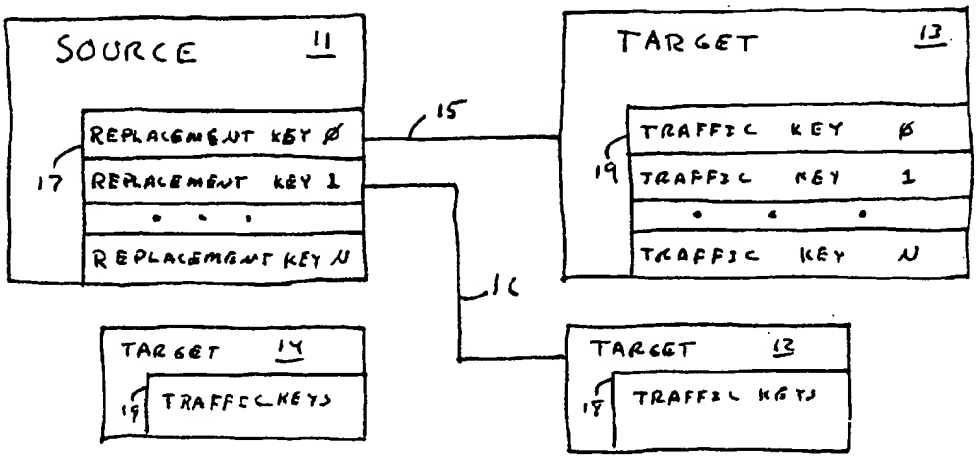


FIG. 1
– PRIOR ART –

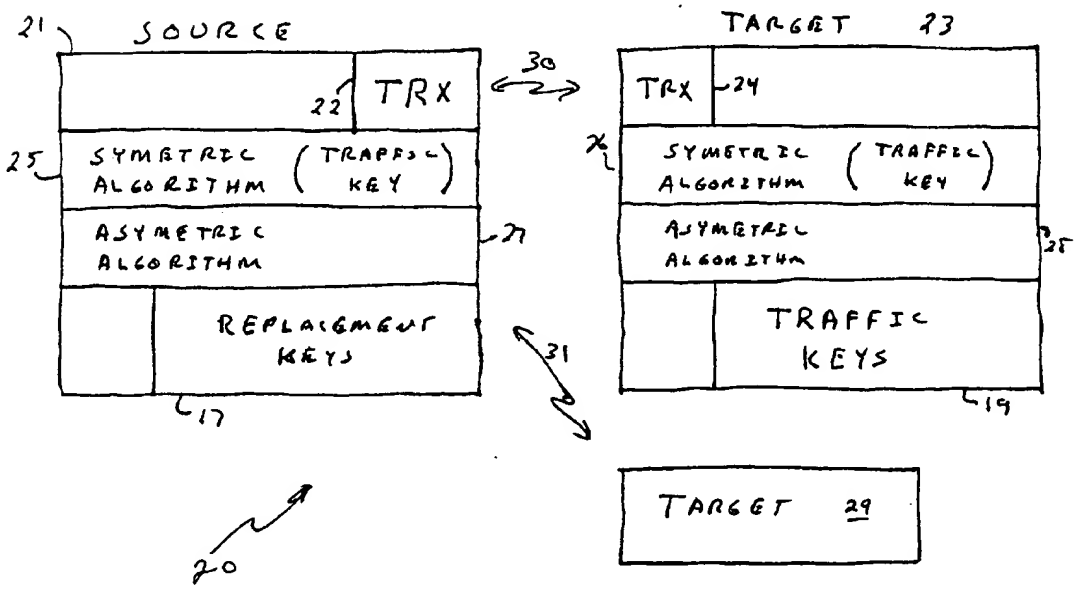


FIG. 2

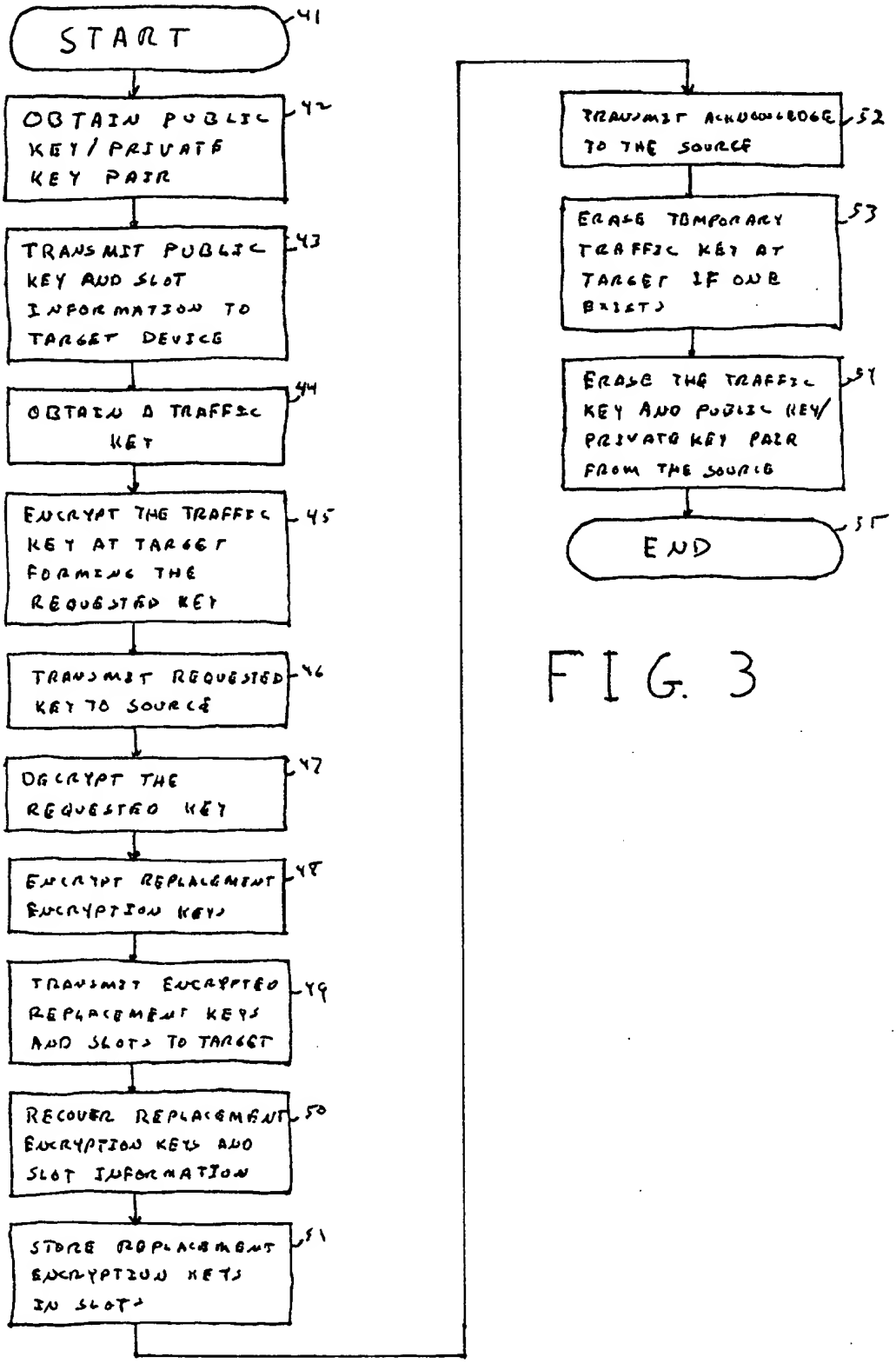

START
41
OBTAIN PUBLIC KEY/PRIVATE KEY PAIR
42
TRANSMIT PUBLIC KEY AND SLOT INFORMATION TO TARGET DEVICE
43
OBTAIN A TRAFFIC KEY
44
ENCRYPT THE TRAFFIC KEY AT TARGET FORMING THE REQUESTED KEY
45
TRANSMIT REQUESTED KEY TO SOURCE
46
DECRYPT THE REQUESTED KEY
47
ENCRYPT REPLACEMENT ENCRYPTION KEYS
48
TRANSMIT ENCRYPTED REPLACEMENT KEYS AND SLOTS TO TARGET
49
RECOVER REPLACEMENT ENCRYPTION KEYS AND SLOT INFORMATION
50
STORE REPLACEMENT ENCRYPTION KEYS IN SLOTS
51
TRANSMIT ACKNOWLEDGE TO THE SOURCE
52
ERASE TEMPORARY TRAFFIC KEY AT TARGET IF ONE EXISTS
53
ERASE THE TRAFFIC KEY AND PUBLIC KEY/PRIVATE KEY PAIR FROM THE SOURCE
54
END
55

FIG. 3

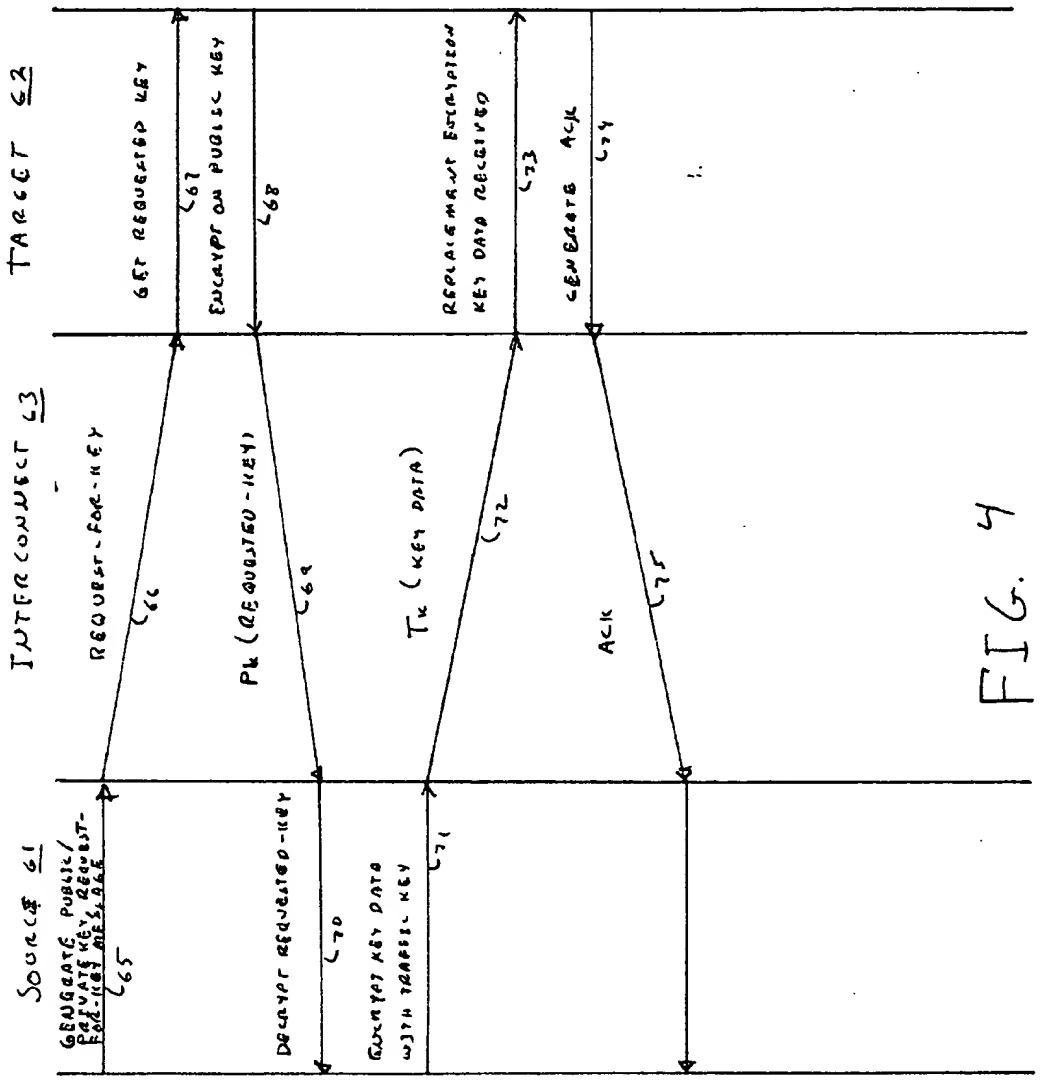

SOURCE 61
INTERCONNECT 63
TARGET 62
GENERATE PUBLIC/PRIVATE KEY, REQUEST-FOR-KEY MESSAGE
65
REQUEST-FOR-KEY
66
GET REQUESTED KEY
67
ENCRYPT ON PUBLIC KEY
68
Pk (REQUESTED-KEY)
69
DECRYPT REQUESTED-KEY
70
ENCRYPT KEY DATA WITH TRANSFER KEY
71
Tk (KEY DATA)
72
REPLACEMENT ENCRYPTION KEY DATA RECEIVED
73
GENERATE ACK
74
ACK
75

FIG. 4

METHOD FOR TRANSFERRING AN ENCRYPTION KEY

FIELD OF THE INVENTION

[0001] The present invention relates, in general, to secure communication, and, more particularly, to the transfer of encryption keys for secure communications.

BACKGROUND OF THE INVENTION

[0002] In order to provide secure communications between devices, it is generally necessary to utilize some form of encryption. Various types of encryption techniques are available in the marketplace. These different techniques all have the same basic premise that both ends of the communication have knowledge of the encryption key being used by the other.

[0003] From time-to-time, it becomes necessary to change the encryption keys so that the secure communications will not be compromised over time by an eavesdropper. Presently, a source device, such as a Key Variable Loader (KVL) manufactured by Motorola Inc. is utilized to change the encryption keys in various target devices. These target devices include any device that utilizes encryption (e.g. radio base stations, mobile and portable radios, and console interface unit, and digital interface unit used in communication systems). A source device, such as the KVL, is generally coupled to the target device by some form of wireline, such as a cable. The direct connect enables the KVL to communicate with the source device directly. As a result, the new encryption keys being transferred are transferred in the clear (i.e. not encrypted) to the target devices.

[0004] However, since the KVL is designed to work with a variety of equipment, the cable connection requires that availability of a number of cables to be able to interface with the different target equipment. Therefore, a need exists to provide a device and system that does not require the myriad of cables necessary to service the various target equipment. A solution to this is to use a wireless interconnect such as an infra-Red (IR) connection or a Radio Frequency (RF) connection to transfer the data. Using a wireless means to transfer the data can leave the transfer open to intercept and can result in the encryption key transfer process being compromised. Therefore, a need exists for the ability to transfer replacement encryption keys over a wireless connection to the targets in a secure manner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] **FIG. 1** is a prior art block diagram of system used to update encryption keys between a source device and a target device;

[0006] **FIG. 2** is a block diagram of system capable of utilizing the present invention;

[0007] **FIG. 3** is a flow chart illustrating a method for transferring an encryption key; and

[0008] **FIG. 4** is a call flow diagram illustrating a method for transferring an encrypted key.

DETAILED DESCRIPTION OF THE DRAWINGS

[0009] Referring initially to **FIG. 1**, a prior art block diagram of a system, generally designated **10**, used to update encryption keys is illustrated. System **10** basically consists of a source **11**, a target **13**, and a wireline connection **15** extending between source **11** and target **13**. Source **11** will contain one or more replacement keys **17**. Target **13** will contain one or more traffic keys **19**, which are used for session keys during communication transfers. Once source **11** is connected to target **13** over wireline **15**, the replacement key(s) is(are) transferred to target **13** to replace traffic key(s) **19**. This transmission of the replacement keys is performed in the clear (not encrypted) since there is a direct wireline connection **15**.

[0010] The same source **11** is also used to update similar traffic keys in targets **12** and **14**. However, different cables **16** and **18** are needed for targets **12** and **14**, respectively. This creates a problem in having to maintain a supply of a myriad of cables to be able to handle different targets.

[0011] In **FIG. 2**, a block diagram a system, generally designated **20**, capable of utilizing the present invention is illustrated. System **20** consists primarily of a source **21** and a target **23**. Source **21** and target **23** comprise wireless transceivers (TRX) **22** and **24**, respectively. Source **21** and target **23** each also contain symmetrical encryption algorithms **25** and **26** as well as asymmetrical encryption algorithms **27** and **28**. Source **21** also contains the replacement encryption keys **17** while target **23** contains the traffic keys **19**.

[0012] A wireless interconnect is established between source **21** and target **23** over link **30**. The replacement keys are transferred from source **21** to target **23** using the method described in more detail in the flow chart of **FIG. 3**

[0013] **FIG. 3** is a flow diagram illustrating a method, generally designated **40**, for transferring a replacement encryption key. Method **40** starts at step **41** and proceeds to step **42** where a public key is obtained. The public key is actually a public key/private key pair which is generated in the source using one of various publicly available methods. This public key/private key pair may be generated using, as an example, portions of a random key stroke file; a real time clock; and/or the output of a linear feedback shift register (LFSR). The public key portion and list of slots are then transmitted from the source device to the target device, step **43**. The slot information is sent to the target device as a means of suggesting a traffic key to be used in the reply message. This transmittal is, in one example, in the form of a request for key message.

[0014] The target then obtains a traffic key, step **44**. This traffic key is used as the session encryption key for the communication being established. The traffic key may be obtained by utilizing one of the traffic keys stored in the target device, or by generating a temporary traffic key within said target device in a manner similar to the creation of the public key/private key pair generated in the source device.

[0015] The target device then encrypts the traffic key using the public key provided by the source device, step **45**, forming a requested key. The requested key is then transmitted to the source, step **46**.

[0016] The source will then decrypt the received requested key using the private key, step **47**. This results in both ends of the link having the same traffic key for communication. The traffic key is then used to encrypt one or more replacement encryption keys, step **48**, for transmission to the target.

The encrypted replacement keys are then formatted into a message along with slot information to be transmitted to the target. The slot information will identify to the target where the replacement encryption keys are to be stored. This slot information may also be encrypted. The message with the encrypted replacement keys and slot information is then transmitted to the target device, step **49**.

[0017] Method **40** then recovers the replacement encryption keys and slot information at the target using the traffic key, step **50**. The slot information is then used to identify which traffic keys are to be replaced by the replacement encryption keys and the replacement encryption keys are then stored in those locations, step **51**.

[0018] An acknowledge is then transmitted from the target to the source, step **52**, indicating to the source that the encrypted replacement keys were received. If the traffic key was generated within the target device as a temporary traffic key, then the temporary traffic key will be erased at the target, step **52**, once the acknowledge is sent. If the target device had chosen a traffic key from its list of stored keys, then the traffic key is not erased at this time; but may have been overwritten by a replacement encryption key during the above process. Upon receipt of the acknowledge, the source will erase the traffic key as well as the public key/private key pair, step **53**. Method **40** then ends, step **55**.

[0019] Another illustration of a method utilizing the present invention is in the call flow diagram, generally designated **60**, of **FIG. 4**. **FIG. 4** shows the processing of a source **61**, a target **62**, and an interconnect **63**, which, as illustrated here, will also function over a wireline interconnect as well as a wireless interconnect. The message flow **60** begins at **65** with the generation of the public/private key pair and placing the public key in a request-for-key message. The request-for-key is then transmitted over interface **63** to target **62**, step **66**. Target **62** then retrieves the requested traffic key, step **67**. The traffic key is encrypted using the public key and placed in a Pk(requested-key) message, step **68**. The Pk(requested-key) message is then transmitted by target **62** to source **61** at step **69**. Source **61** decrypts the received Pk(requested-key) message to obtain the traffic key, step **70**. The replacement encryption key(s) is(are) then encrypted into a Tk(key data) message by source **61**, step **71**. The Tk(key data) is then transmitted to target **62**, step **72**. The received Tk(key data) is decrypted by target **62** and the replacement encryption key data is received, step **73**, and stored in the appropriate traffic key slots.

[0020] An acknowledge (ACK) is then generated by target **62**, step **74**, and transmitted to source **61**, step **75**. The target device may then erase the traffic and private keys used and the source may erase the public, private, and traffic keys used.

[0021] The processes described in **FIGS. 3 and 4** illustrate the use of the present invention to permit secure transfer of encryption keys over an open interface in a manner which does not compromise the integrity of the encryption keys being transferred.

[0022] While the invention has been described in conjunction with specific embodiments thereof, it is evident that many alterations, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alterations, modifications, and variations in the appended claims.

1. A method for transferring a replacement encryption key, said method comprising the steps of:

transmitting a public key from a source device to a target device;

encrypting a traffic key within said target device using said public key thereby forming a requested key;

transmitting said requested key to said source device;

encrypting said replacement encryption key using said traffic key at said source device forming an encrypted replacement key;

transmitting said encrypted replacement key to said target device; and

recovering said replacement encryption key.

2. The method of claim 1 wherein said method further comprises the step of generating said public key and a private key in said source device.

3. The method of claim 2 wherein said public key and said private key are generated using a data set.

4. The method of claim 3 wherein said data set comprises at least a portion of one of a key stroke file, a real time clock, and an output from a linear feedback shift register.

5. The method of claim 2 wherein said method further comprises the step of decrypting said requested key using said private key at said source device.

6. The method of claim 1 wherein said method further comprises the step of selecting said traffic key from within said target device.

7. The method of claim 1 wherein said method further comprises the step of receiving said encrypted replacement key at said target device.

8. The method of claim 1 wherein said method further comprises the step of storing said replacement encryption key at said target device.

9. The method of claim 1 wherein said step of transmitting said public key transmits said public key using at least one of a wired connection, a radio frequency connection, and an infrared connection.

10. The method of claim 1 wherein said step of transmitting said public key comprises the step of transmitting said public key in a message.

11. The method of claim 10 wherein said step of transmitting said requested key comprises the step of transmitting said requested key in a message.

12. The method of claim 11 wherein said message further comprises a key slot within said target device to be used to identify a location for storage of said replacement encryption key.

13. The method of claim 2 wherein said method further comprises the step of acknowledging receipt of said encrypted replacement key by said target device.

14. The method of claim 13 wherein said method further comprises the steps of:

erasing said traffic key from said source device; and

erasing said public key and said private key from said source device.

15. A method for transferring a replacement encryption key, said method comprising the steps of:

obtaining a public key and a private key from a source device;

transmitting said public key from said source device to a target device;

obtaining a traffic key from within said target device;

encrypting a traffic key within said target device using said public key thereby forming a requested key;

transmitting said requested key to said source device;

decrypting said requested key using said private key at said source device;

encrypting said replacement encryption key using said traffic key at said source device forming an encrypted replacement key;

transmitting said encrypted replacement key to said target device;

recovering said replacement encryption key; and

storing said replacement encryption key at said target device.

16. The method of claim 15 wherein the step of obtaining said traffic key comprises one of selecting an existing traffic key and generating said traffic key.

17. The method of claim 15 wherein the step of transmitting said encrypted replacement key comprises a message identifying at least one replacement key and a storage location for each replacement encryption key.

18. The method of claim 15 wherein the step of recovering said replacement encryption key comprises the step of decrypting said encrypted replacement key at said target device using said traffic key.

19. The method of claim 15 further comprising the steps of:

acknowledging receipt of said encrypted replacement key by said target device;

erasing said traffic key from said source device and said target device; and

erasing said public key and said private key from said source device.

20. A method for transferring a plurality of replacement encryption keys, said method comprising the steps of:

obtaining a public key and a private key from a source device;

transmitting said public key from said source device to a target device;

obtaining a traffic key from within said target device;

encrypting a traffic key within said target device using said public key thereby forming a requested key;

transmitting said requested key to said source device;

decrypting said requested key using said private key at said source device;

encrypting said plurality of replacement encryption keys using said traffic key at said source device forming an encrypted replacement key message which further contains a target slot identification for each of said plurality of replacement encryption keys;

transmitting said encrypted replacement key message to said target device;

recovering said plurality of replacement encryption keys from said encrypted replacement key message; and

storing said plurality of replacement encryption keys at said target device in a target slot identified for each of said plurality of replacement encryption keys.

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